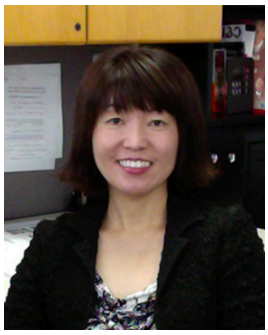
Department of Chemical Engineering Seminar Series

Materials Chemistry via Electrochemistry: Electrochemical Synthesis of Semiconductor Electrodes and Catalysts for Use in Solar Energy Conversion



Kyoung-Shin Choi
Professor, Chemistry
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Monday, November 10, 2014
Lecture: 4:00-5:00 p.m.
BAGLEY 154
Reception at 3:15 p.m. – Benson Lobby

Abstract

Harvesting energy directly from sunlight as nature accomplishes through photosynthesis is a very attractive and desirable way to solve the energy challenge. Many efforts have been made to find appropriate materials and systems that can utilize solar energy to produce chemical fuels. One of the most viable options is the construction of a photoelectrochemical cell that can reduce water to H_2 or CO_2 to carbon-based molecules. For successful construction of photoelectrochemical cells, simultaneous developments of photoelectrodes, which will efficiently capture photons to generate and separate electron-hole pairs, and catalysts, which will facilitate the use of photongenerated electrons and holes for desired interfacial charge transfer reactions, are necessary. Furthermore, optimally interfacing photoelectrodes and catalysts is critical because the photoelectrode/catalyst interface can govern the overall efficiency of the integrated photoelectrode system. However, our understanding of the photoelectrode/catalyst interfaces has been limited because not many systematic investigations on the assembly of photoelectrodes and catalysts were reported.

Our research group has been developing new electrochemical synthesis conditions to produce semiconductor electrodes and catalysts with various compositions and architectures. In this presentation, we will discuss properties of electrochemically deposited semiconductor electrodes and new strategies to optimally interface them with catalysts. The systems we will discuss include a $BiVO_4$ photoanode paired with dual layers of oxygen evolution catalysts, FeOOH and NiOOH, that achieves a current density of 2.73 mA/cm^2 at 0.6 V vs. reversible hydrogen electrode (RHE) for solar water splitting in a stable manner under AM 1.5G, 100 mW/cm^2 illumination.

Speaker Biography

Kyoung-Shin Choi is Helfaer Professor of Chemistry at University of Wisconsin-Madison. She received her B.S. and M.S. degrees from Seoul National University in South Korea in 1993 and 1995, respectively. She received a Ph.D. degree from Michigan State University in 2000 (with Prof. Mercouri Kanatzidis), and then spent two years at the University of California, Santa Barbara as a postdoctoral researcher (with Prof. Galen Stucky). She joined the chemistry faculty at Purdue University as an assistant professor in 2002, and was promoted to an associate professor in 2008. She was a visiting scholar at the National Renewable Energy Laboratory (NREL) in 2008. Her specific research interest lies in the construction of multi-component composite electrodes with optimum overall architectures and interfaces. She was a recipient of a 2006 Alfred P. Sloan Research Fellowship, the 2007 ACS ExxonMobil Faculty Fellowship in Solid-State Chemistry, and the 2010 Iota Sigma Pi Agnes Fay Morgan Research Award. She also received the 2008 Purdue College of Science Outstanding Undergraduate Teaching Award. She was a 2011 volume organizer for Materials Research Society (MRS) Bulletin and the 2011 Chair of the American Chemical Society-Division of Inorganic Chemistry, Solid State Chemistry sub-division. She also organized two symposia for MRS meetings on Crystal Shape Control and Shape Dependent Properties (2008) and Solid State Chemistry (2010). She served as the 2014 Chair of the Gordon Research Conference: Electrodeposition and is currently serving as an Associate Editor for Chemistry of Materials.